



International Journal of Allied Practice, Research and Review
Website: www.ijaprr.com (ISSN 2350-1294)

JADE MOBILE AGENTS – AN EFFICIENT SOLUTION FOR DISTANCE EVALUATION SYSTEM

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ABSTRACT- Mobile Agents are a useful approach for many distributed applications. A Mobile Agent does not require a permanent connection to the computer from which it was launched. The agent does not care if the computer that launched it becomes disconnected because it can pursue its search operations independently. Moreover, agents are an efficient paradigm for information processing and transfer over wireless networks, which typically have low bandwidth and high latency. By migrating to the location of an electronic resource, an agent can access the resource locally and eliminate costly data transfers over congested networks. This reduces network traffic and improves data delivery, because it is often faster and cheaper to send a small agent to a data source than to send all the intermediate data to the requesting site. We analyze various vital benefits of JADE Mobile Agent (1) conservation of bandwidth, (2) reduction in latency, (3) reduction in total completion time, (4) support for disconnected operation in mobile computing, (5) load balancing.

Keywords - Mobile Computing, Mobile Agent, JADE, Distance Evaluation, FIPA.

I. INTRODUCTION

In the past few years there has been an growth of interest in mobile agent technology and several platforms have been developed. Some of them have only been used for research purposes while others have been deployed as commercial products. The society is now looking for applications where these platforms can be effectively used. A Mobile Agent is an emerging technology that is gaining momentum in the field of distributed computing. The use of mobile agents can bring some interesting advantages when compared with traditional client/server solutions, it can reduce the traffic in the network, it can provide more scalability, it allows the use of disconnected computing and it provides more flexibility in the development and maintenance of the applications. In the latest years, several commercial implementations of mobile agent systems have been presented in the market

II. THE JADE PLATFORM

The platform chosen for implementing migration was JADE, because it is a widely adopted platform within the software agent development and research communities. It is open source and complies with FIPA specifications. This platform facilitates its agents' mobility, but as shown below, does not meet the requirements for a real migration. The platform is divided into a large number of functional modules, which can be placed into three categories in general terms: Core. The core of the platform is formed by all components providing the necessary execution environment for agents' functioning. This consists of the agency's mechanisms for carrying out information processing in ACL messages, and the internal structures that the agency and agents will use to represent this content. Mechanisms and protocols used to send and receive messages at both intra-agency and inter-agency level. At the core of the JADE platform is the concept of the container, which is the minimum execution environment necessary for an agent to operate. Each

container in JADE is executed in a different Java virtual machine, but they are all interconnected by RMI (Remote Method Invocation). Containers do not only enable groups of agents to be separated into different execution groups, but agencies may also be distributed in various machines so that each has one or several of them. One of the different existing containers is the principal, which represents the agent itself and which gives orders to all the others. JADE also provides mobility between containers. For this reason, if the agency is distributed in various machines, agents can move between them. However, accepting this type of mobility as migration could be considered a mistake. "Satellite" containers are highly dependent on the principal and many operations carried out by the agents within them end up passing through the central node. Furthermore, the connections between them (carried out by RMI) must be permanent, as if not, many errors due to the loss of link may be generated. As we can see, using this type of mobility as a typical migration ends up making Mobile Agent systems' scalability disappear because a certain type of operations is centralized in a single node. However, it may be very useful to use the diagram of containers to distribute the processing of agencies that have to bear a heavy load or to isolate some agency types within a single agency for security reasons. These details lead to the necessity for inter-agency migration, which is carried out through a non-permanent channel and makes a system of Mobile Agents available that is much more scalable, and in which agencies are totally independent units. This independence is not only desirable from the point of view of fault tolerance, but also because of privacy.

III. KEY BENEFITS OF JADE

JADE (Java Agent Development Framework) is a software framework fully implemented in the Java language. It simplifies the implementation of Multi Agent systems through a middle-ware that claims to comply with the FIP A specifications and through a set of tools that supports the debugging and deployment

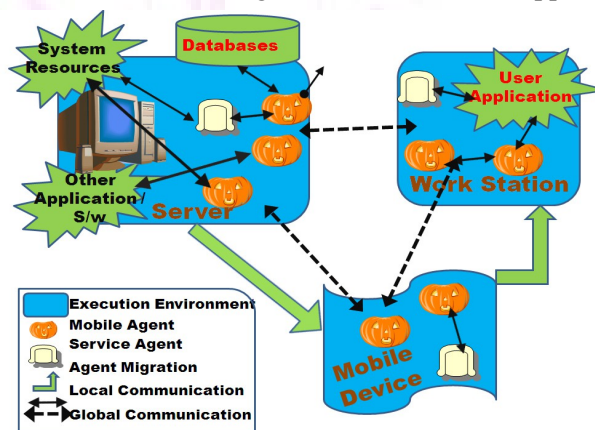


Figure 1 : Structure of Mobile Agent

phase. JADE agent platform tries to keep high the performance of a distributed agent system implemented with the Java language. In particular, its communication architecture tries to offer flexible and efficient messaging, transparently choosing the best transport available and leveraging state-of-the-art distributed object technology embedded within Java runtime environment. JADE uses an agent model and a Java implementation that offer a good runtime efficiency and software reuse. This framework is built using the combination of two main products: a FIPA-compliant agent platform and a package to develop Java agents. When this tool is selected to build the Multi-Agent System, it has both advantages and disadvantages that could be summarized in: Jade does not have a powerful programming environment; this framework only provides to the user a set of interfaces that allow him to debug the implemented agents. One of the better characteristics in Jade is that it has an excellent documentation, a good API to reuse the provided libraries to build new agents. Using Jade, a set of communication libraries (or packages) is provided to the software engineers, those libraries allow them to isolate the communication problem.

JADE allows developers to easily build intricate, real-world business models without being constrained by the mechanics of storing and accessing data. With JADE, developers can store, retrieve and rapidly traverse complex, interconnected object structures as though they are always in memory. JADE entirely eliminates the development effort required to move objects to and from a database (often referred to as

impedance mismatch). This makes developers more productive. Coupled with a flexible distributed processing model, JADE is ideal for solving complex problems. JADE makes it easier to build and run distributed systems that take advantage of modern, high-performance hardware platforms. Built on more than 25 years of company experience, JADE reduces the complexity of software development by delivering for Windows and Linux a seamless fusion of:

- A proven, high-performance object database that makes the storage, retrieval and traversal of complex object models transparent.
- An object manager and application servers that provide automatic object caching, powerful distributed processing capabilities and interfaces to other languages.
- Web Services to interoperate with other systems and technologies.
- A high-grain, conceptually economic programming model that makes it easier to implement complex business processes.
- A Synchronized Database Service (SDS) that provides hot-standby facilities and the ability to distribute read-only tasks to secondary databases.
- A Relational Population Service (RPS) that makes it easy for JADE systems to populate relational databases for Business Intelligence (BI) and data warehousing purposes.
- An automatic, portable thin client that enables rich user interfaces to be deployed easily over the Internet to both Windows and Linux desktops.
- A clear, concise, easy-to-learn programming language.
- A repository-based development environment that enables collaborative thin client development from anywhere in the world.
- HTML frameworks for delivery of browser-based user interfaces.

1) JADE is able to simplify development while ensuring standard compliance through a comprehensive set of system services and agents and

2) JADE offers an agent runtime system on which implement efficient FIPA 2000 compliant multi-agent systems and supports their development through the availability of a predefined programmable agent model and of a set of management and testing tools.

Java Agent DEvelopment Framework (JADE) is a framework that facilitates the development of agent applications in compliance with the FIPA specifications for interoperable intelligent multi-agent systems. The JADE agent platform tries to keep the high performance of a distributed agent system implemented with the Java language. It is also a middleware for developing distributed applications through leveraging state-of-the-art distributed object technology embedded within the Java runtime environment. Therefore, the goal of JADE is to simplify the development while ensuring standard compliance through a comprehensive set of system services and agents. JADE uses an agent model that allows high runtime efficiency, software reuse, agent mobility, and the realization of different agent architectures.

1. Distributed autonomous applications development - Agents that are autonomous, intelligent, and capable of communicating and collaborating need to be implemented. JADE simplifies such a development.

2. Negotiation and coordination - JADE provides easy-to-use software libraries (i.e. patterns of interaction between agents) to solve negotiation and coordination among a set of agent, where the resources and the control logics are distributed in the environment.

3. Pro-activity - JADE agents have been designed to control their own thread of execution. These agents can be easily programmed to initiate the execution of actions without human intervention just on the basis of pre-defined goals and state changes. The property of pro-activity is essential in designing physician agents of Distance Evaluation, which requires controlling their own actions guided by regulations.

4. Multi-Party applications - Peer-to-peer architectures that JADE used are more efficient than client-server architectures for developing multi-party applications. Sometimes, the server might become the bottleneck and the point of failure in the entire system. The implementation of Distance Evaluation based on JADE architecture that allows clients to communicate each other without the intervention of a central server and subsequently reduces the network traffic.

5. Interoperability - JADE complies with the FIPA standard that enables end-to-end interoperability between agents of different agent platforms.

6. Versatility - JADE provides a homogeneous set of APIs that are independent from the underlying network and Java version. It also provides the same APIs for J2EE, J2SE, and J2ME environments. This feature makes Distance Evaluation a heterogeneous client (PC, PDA, mobile phone, etc.) environment.

7. Ease of use - JADE APIs and ready to use functionalities can shorten the system development cycle The JADE-implemented Distance Evaluation is hence expected to be capable of integrating disparate information sources and isolated heterogeneous components to perform autonomous Examination Process.

IV. A TECHNICAL NOTE

JADE Java Agent Development Framework is a software Framework fully implemented in Java language developed by Tilab for the development of multi-agent applications based on peer-to-peer communication architecture.

It simplifies the implementation of Agent systems through a middle-ware that complies with the latest Foundation for intelligent physical agents (FIPA) 2000 specifications. It provides a set of graphical tools that supports the debugging and deployment phases of agent development. Jade permits the intelligence, information & resources to be distributed over the network in the form of java compatible mobile devices like PDA, pagers, cell phones, smart phones, laptops or fixed desktops etc. The communication environment evolves gradually with the appearance and disappearance of various peers, known as agents in Jade according to their needs and requirements.

II. JADE MOBILE AGENT & DISTANCE EVALUATION SYSTEM

We have presented the design and development of a mobile agent based application for Distance Evaluation, the system, known as Mobile Agent Bases System of Distance Evaluation. JADE provides mobile agent platform. Agents are implemented by extending JADE class. The agents in Mobile Agent Bases System of Distance Evaluation are made up of from main three elements and sub corresponding elements

- 1- Examination Setting - Launcher, PaperCoordinator, InstallAgent, FetchAgent, RemoteSetterGUI, NamingService.
- 2- Distribution and Testing Stage - PaperCourierAgent, DistributionServer, PaperGUI, AnswerAgent.
- 3- Evaluation and Result Compilation Stage - AnswerAgent, ObjectiveEvalServer, Examiner, PublishResultGUI.

These main and sub agents, representing examination system, students and administrators, are capable of conducting the examination and evaluation tasks. Mobile Agent Bases System of Distance Evaluation minimizes human intervention in the examination and evaluation registration process. Examiner and evaluators involvements have been reduced to manual conducting and evaluation of examination. In addition, the system adopts a distance evaluation of examination style that allows students to give the examination from remote places and remove complexity and save time to distribution and compilation of result.. Comparisons made against an existing traditional examination web based system show that the mobile agent approach has the clear advantages of The capability of intelligent agents to autonomously perform simple tasks has aroused much interest..

III. ROLE OF MOBILE AGENT IN DISTANCE EVALUATION

As already discussed, a number of factors influence Mobile Agent Technology use in Examination System. In the proposed model, Examination Process involves three stages as follows:

- (i) Examination setting,
- (ii) Distribution and testing, and
- (iii) Evaluation and result compilation

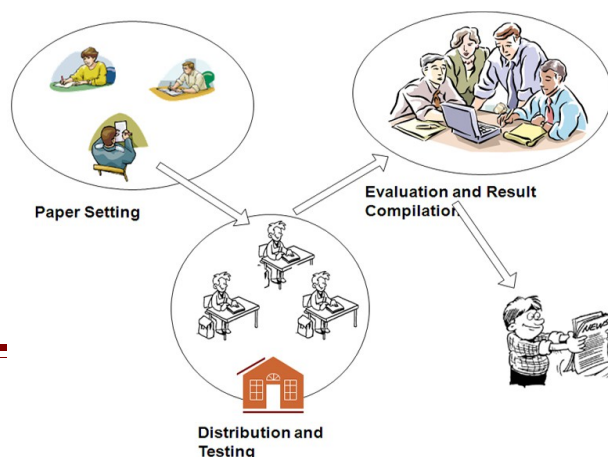


Figure 2 : Examination System

This is shown in Figure as seen in the figure, the independent variables to determine a suitable indicator for Mobile Agent use in Distance Evaluation. The proposed model in this study is derived from Examination System practice in India.

VII. CONCLUSION

In this research paper, we survey & studies several Mobile Agent Systems, all the systems in this paper focused mainly on the environment provided by the system for agents, the mechanisms for agent mobility, agent communication, and language support. The use of Mobile Agents appears to offer certain advantages for client-server computing but as we've noted in the above systems, it also raises some difficult issues with respect to efficiency, flexibility and security. These issues have an effect on an agent's ability of mobility. Many important issues such as how agents determine the available resources/services on a machine it transferred to mobile agent system-to-OS interaction, the use of persistent storage, and support for failure were either briefly discussed. Mobile Agents need more applications that take advantage of the characteristics of mobile agents since there is no single alternative to all of the functionality supported by a Mobile Agent Framework. A potential application for JADE Mobile Agents would involve the use of the Internet and the many uses of the Internet. Solutions to the security and virus problems in Mobile Agents could also result in new and successful methods of Client-Server interaction in network services. As above discussion, we select the JADE Mobile Agent Framework for implementing the Distance Evaluation Model.

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